POISONOUS FISHES AND ICHTHYOSARCOTOXISM

Their Relationship to the Armed Forces

BRUCE W. HALSTEAD, *M. D.*
W. M. LIVELY, Jr., *M. D.*

THE danger of serious illness or death resulting from fish poisoning is emphasized again by an outbreak that occurred on 21 March 1953 among a number of naval Mid-Pacific contract personnel at the Kwajalein Naval Base in the Marshall Islands, following ingestion of a black moray eel. Five of the victims became violently ill and a sixth died, terminating an illness of about five weeks. The clinical details of this incident and a preliminary analysis of the toxins involved are discussed elsewhere.[1] This recent outbreak was similar to that of moray eel poisoning which involved 57 Filipino contract workers on Saipan on 8 May 1949.[2] The more striking symptoms in these patients consisted of ataxia, paralyses, numbness of the limbs, aphonia, laryngeal spasm, violent convulsions, and coma. In the Saipan outbreak, two of the victims died despite excellent medical care.

According to reports received from Japanese sources, more than 400 military persons succumbed to fish poisoning in Micronesia during World War II. Because of these intoxications the Japanese Navy requested the Nissan Fisheries Institute of Odawara, Japan, to conduct a survey of the poisonous fishes of Micronesia. The study was accomplished by Dr. Yoshio Hiyama of the Tokyo University. The final results were published in the form of both civilian and military handbooks.[3] All of the Japanese editions were profusely illustrated in color.

During 1944-1945, the United States Military Government at Saipan established the post of fish commissioner. It was the duty of this office to develop a fisheries program to provide our armed services in the Mariana Islands with fresh fish at the rate of 35 pounds per 100 rations per week. As the result of this

From the School of Tropical and Preventive Medicine, College of Medical Evangelists, Loma Linda, Calif.

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program and the fishing experiences of individual military personnel, it was found that numerous species of commercially valuable fishes were toxic. On 21 June 1945, Rear Admiral F. E. M. Whiting, issued a directive which listed the following fishes as poisonous: barracuda, brown surgeonfish, puffers, pompano, horse mackerel, butterfly fish, red snapper, sea bass, perch, moonfish, triggerfish, and parrot fish. Moreover, it was required that all fishes taken by private fishing parties be inspected by the fish commissioner. Despite these precautions intoxications occurred. Vonfraenkel and Krick[4] and Cohen and associates[5] reported outbreaks involving 30 and 51 persons, respectively. Numerous other cases were said to have occurred which did not appear in the literature.[6]

During 1943, Dr. Wilbert McLeod Chapman of the United States Board of Economic Warfare visited bases throughout the tropical Pacific for the purpose of establishing a fisheries program on a semicommercial scale to provide a fresh fish supplement to the diet of military personnel stationed in these areas. He[7] found that they were continually harassed by the ever-present threat of fish poisoning. During December to February in certain regions in New Caledonia all carnivorous fishes were considered to be dangerous to eat and, in the Ellice Islands, a particular species would be poisonous in one area and harmless in another. The conflicting and frequently erroneous information supplied by natives complicated the problem.

Dr. Leonard P. Schultz,[8] Curator of Fishes, U. S. National Museum, stated that he was frequently consulted by various branches of the armed services for data regarding poisonous fishes. It is an incontestable fact that wherever our forces were stationed in the Indo-Pacific, epidemics of fish poisoning occurred. All too frequently these intoxications were confused with other types of bacterial food poisoning.

Additional information regarding the relationship of poisonous fishes and the military may be found in references 9 through 34. Fish and Cobb[35] prepared an excellent review of the entire subject of noxious marine animals and their relationship to military personnel but, unfortunately, it has not been published. Handbooks and directives, too numerous to list, have issued scores of warnings, recommendations, and advice of sundry kinds but, despite these admonitions and numerous outbreaks among military personnel, the hazards of eating poisonous fishes are frequently underrated.

EPIDEMIOLOGY

Poisonous fishes are widely distributed throughout all warm seas, but are particularly numerous around certain island areas

in the Caribbean, Central, and South Pacific Oceans. It has been estimated that there are about 300 species of poisonous fishes in the Central Pacific. Jensen,[36,37] Boje,[38] and Hjortland[39] reported some of the arctic sharks to be poisonous. The total poisonous fish population of the world is undoubtedly considerably higher because additional poisonous species are continually being added to the list. In a random series of 93 fish species captured in the Phoenix Islands, 29 percent were found to be toxic.[40] In a similar series of 60 species captured at the Johnston Island Air Force Base it was demonstrated that 75 percent of the species were toxic.[41] Fish poisoning at Johnston, Line, and Midway Islands is believed to have been part of a general outbreak which apparently started in that area about 1943. Prior to that time poisonous fishes, aside from puffers and other plectognaths, were unknown. Whether this is something new or a cyclic phenomenon remains to be determined. There is no evidence to indicate that any given species of fish, exclusive of puffers, is inherently toxic or toxic all of the time. Apparently a fish becomes poisonous as a result of its food habits. It is believed that the toxic food cycle is initiated by a marine plant of some type. The validity of this theory is now under investigation. Any reef or shore fish is potentially poisonous if captured in an endemic area. Unfortunately, the exact geographic boundaries of these areas are unknown. Moreover, a commercially valuable species in one area may be deadly poisonous in another. The bulk of the research conducted thus far has been devoted to determining the species identification of the disease agents and their geographic distribution.

Reports regarding the seasonal incidence of the disease are conflicting. A few species, such as barracuda and puffer, appear to be more toxic during the reproductive season of the year, but apparently this is not true of most other fishes. Existing records reveal that fish poisoning may occur during any season of the year. Most puffer species are poisonous about 90 percent of the time, and particularly so during their reproductive period. Ingestion of an ounce of the liver or flesh of some puffers has been known to kill a person within 17 to 20 minutes. In general, the visceral organs of a fish, viz., liver, intestines, and roe, are more likely to be toxic than the musculature, and should never be eaten. Because of the paucity of reliable date, epidemiologic studies will of necessity have to continue for some years to come.

A partial list of the fishes most frequently found to be toxic appears in table 1. The list is grossly incomplete and has been provided merely to give the reader some idea of the phylogenetic extent of toxic fishes.

TABLE 1. *A partial representative list of fishes known to be poisonous*

Family and scientific name	Common name*	
	English	Hawaiian
ACANTHURIDAE *Ctenochaetus strigosus* (Bennett), fig. 1	Surgeonfish	Maií
BALISTIDAE *Balistoides niger* (Bonnaterre), fig. 2	Triggerfish	Humu-humu
CARANGIDAE *Caranx sexfasciatus* (Quoy and Gaimard), fig. 3	Pompano	Ulua
DIODONTIDAE *Diodon hystrix* (Linnaeus), fig. 4	Porcupine fish	O'opu okala
LABRIDAE *Coris gaimardi* (Quoy and Gaimard), fig. 5	Wrasse	Hinaleas
LUTJANIDAE *Lutjanus vaigiensis* (Quoy and Gaimard), fig. 6	Snapper	Uku
MONACANTHIDAE *Alutera scripta* (Osbeck), fig. 7	Filefish	Oili
MULLIDAE *Parupeneus trifasciatus* (Lacépède), fig. 8	Surmullet, goatfish	Weke

TABLE 1. *A partial representative list of fishes known to be poisonous*—Continued

Family and scientific name	Common name*	
	English	Hawaiian
MURAENIDAE *Gymnothorax javanicus* (Bleeker), fig. 9	Moray eel	Puhi
SCARIDAE *Scarus microrhinus* (Bleeker), fig. 10	Parrot fish	Panuhunuhu
SERRANIDAE *Cephalopholis argus* (Bloch), fig. 11	Sea bass, grouper	Hapu'upu'u
SPHYRAENIDAE *Sphyraena barracuda* (Bloch and Schneider), fig. 12	Barracuda	Kaku
TETRAODONTIDAE *Arothron hispidus* (Linnaeus), fig. 13	Puffer	Maki-Maki

*Because most of these fishes are common throughout the tropical Pacific, both English and Hawaiian names are given.

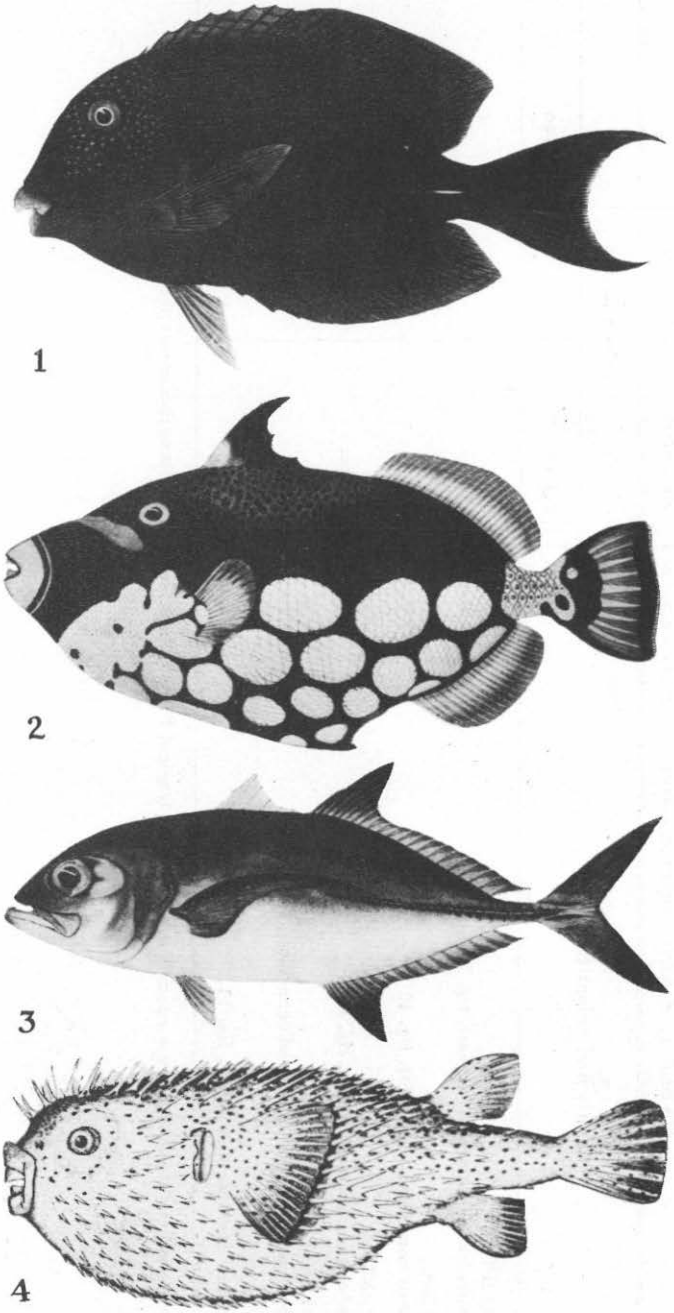

Figure 1. Surgeonfish *(Ctenochaetus strigosus)*. Figure 2. Triggerfish *(Balistoides niger)*. Figure 3. Pompano *(Caranx sexfasciatus)*. Figure 4. Porcupine fish *(Diodon hystrix)*.

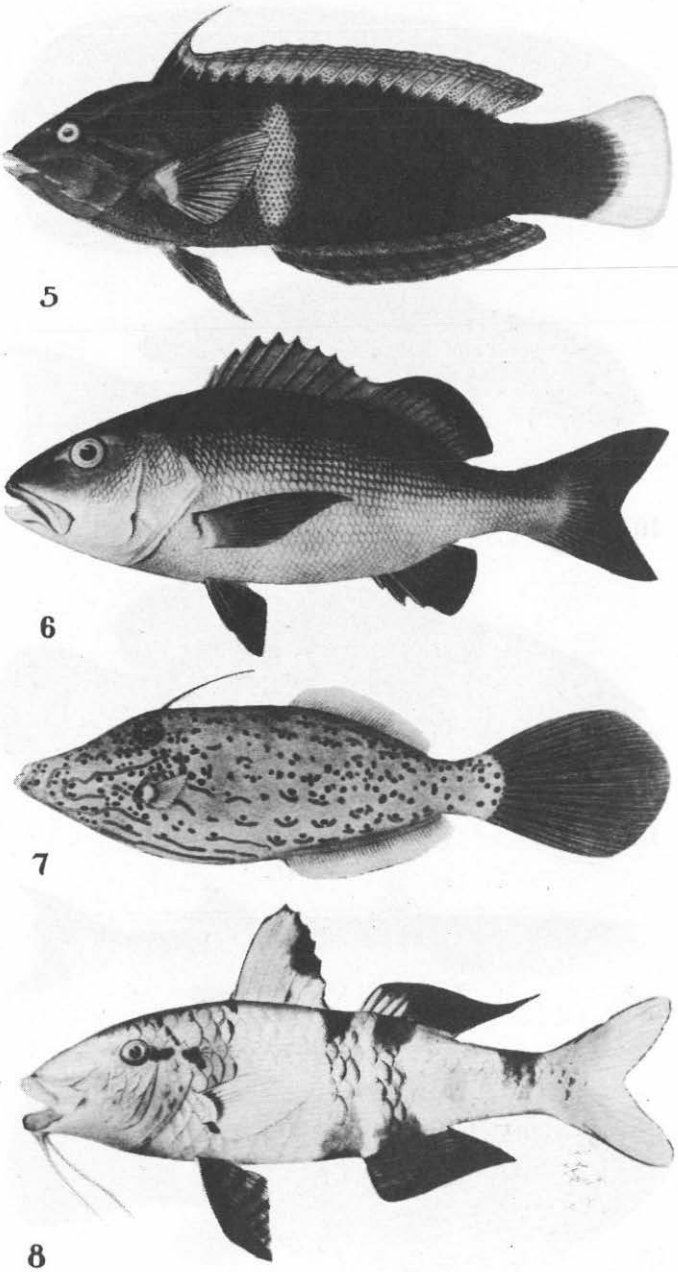

Figure 5. Wrasse *(Coris gaimardi)*. Figure 6. Red snapper *(Lutjanus vaigiensis)*. Figure 7. Filefish *(Alutera scripta)*. Figure 8. Surmullet, or goatfish *(Parupeneus trifasciatus)*.

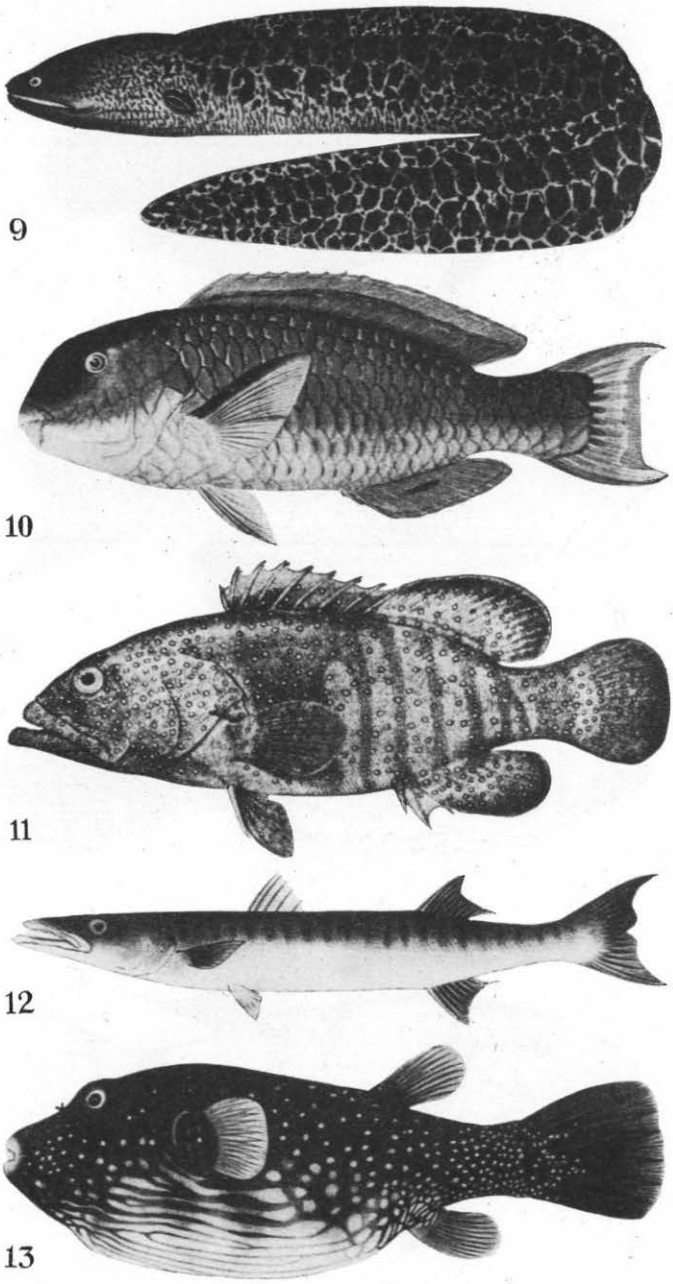

Figure 9. Moray eel *(Gymnothorax javanicus)*. Figure 10. Parrot fish *(Scarus microrhinus)*. Figure 11. Sea bass, or grouper *(Cephalopholis argus)*. Figure 12. Barracuda *(Sphyraena barracuda)*. Figure 13. Puffer *(Arothron hispidus)*.

NATURE OF ICHTHYOSARCOTOXINS

The chemical and pharmacologic properites of most ichthyosarcotoxins, fish poisons, are unknown. Tetraodontoxin or puffer poison has been studied to some extent by the Japanese. Puffer poison, in its purified state, is a white hygroscopic powder, readily soluble in water and insoluble in the ordinary organic solvents. Tetraodontoxin has been assigned the provisional chemical formula of C_{16} H_{31} NO_{16}. Japanese scientists are of the opinion that tetraodontoxin is neither a protein, an alkaloid, nor a protamine. The exact chemical structure and source of the poison are still unknown. Moreover, it is not known whether the ichthyosarcotoxins that are found in such fishes as the snapper, grouper, and moray eel are related to puffer poison, or whether they are a different compound. Most fish poisons (exclusive of puffer poison) appear to have a composite physiologic action on humans. Many of the symptoms are similar in nature to those produced by such compounds as aconitine, muscarine, and curare. Whether or not ordinary fish toxins are true alkaloids remains to be seen. These fish toxins are water soluble and relatively heat stable. Ordinary cooking procedures do not destroy or appreciably alter the virulence of the poison. The state of freshness of the fish has no bearing on the production nor the virulence of the toxin because putrefaction is not a contributing factor in this disease.

CLINICAL CHARACTERISTICS

Clinically, fish poisoning can be divided into four types. The relationship of these types to each other is not clearly understood and the terminology by which they are designated is subject to change.

1. *Tetraodon (puffer) poisoning.* The causative agent is a puffer, one of the members of the suborder Tetraodontoidea. Numbness of the lips, tongue, and tips of fingers and toes usually develops within 30 minutes after the ingestion of the toxin. These symptoms may be followed by nausea, vomiting, headache, dizziness, and generalized weakness, to the extent that the patient can no longer stand erect but must lie down. Power of speech becomes impaired and dyspnea is marked. Within two hours, as a rule, the patient suffers complete paralysis with muscles relaxed and body limp, and is unable to speak although he is conscious. Just prior to death the patient lapses into unconsciousness. Death generally occurs in severe cases within 1 to 24 hours as a result of respiratory paralysis. This is by far the most violent and serious type of ichthyosarcotoxism known. The mortality rate is estimated to be about 60 percent. If the patient survives 24 hours, the prognosis is considered to be good.

2. *Gymnothorax (moray eel) poisoning*. The causative agent is one of the members of the genus *Gymnothorax*. Seven species are definitely known to be toxic; they are: *G. buroensis* (Bleeker), *G. flavimarginatus* (Rüppell), *G. javanicus* (Bleeker), *G. meleagris* (Shaw and Nodder), *G. petelli* (Bleeker), *G. pictus* (Ahl), and *G. undulatus* (Lacépède). Symptoms of tingling and numbness about the lips, tongue, hands, and feet usually develop within 20 minutes to 7 or 8 hours after ingestion of the toxin. These symptoms may be followed by nausea, vomiting, laryngeal spasm, aphonia, excessive mucus production, foaming at the mouth, conjunctivitis, paralysis of the respiratory muscles, motor in-co-ordination, violent colonic and tonic convulsions, abnormal deep and superficial reflexes, and coma. The mortality rate is estimated to be about 10 percent. The excessive mucus production, laryngeal spasm, violent convulsions, and respiratory distress present difficult problems in the handling of these patients. The acute symptoms generally subside within 10 days in the milder forms.

3. *Ciguatera*. This term was originally used to designate fish poisoning, exclusive of puffer poisoning, resulting from the ingestion of fishes in the Caribbean area. However, recent study of the clinical characteristics of the Caribbean and Pacific types of fish poisoning fails to demonstrate any significant differences between them. Since the term ciguatera is well established in the literature it is recommended that this term be used to designate the milder form of ichthyosarcotoxism without reference to geographic location. Numerous species of fishes are capable of producing this type of poisoning (table 1).

Tingling followed by numbness usually develops almost immediately or within a period of 30 hours after ingestion of the toxin. Nausea, vomiting, diarrhea, and abdominal pain are present in about 75 percent of the patients. Joint aches, malaise, chills, fever, prostration, headache, profuse sweating, pruritus, metallic taste, generalized motor in-co-ordination, muscular weakness, and myalgia are common. Sensory disturbances are present in most cases, the patient complaining of hot objects being cold and cold objects as hot or like "electric shock." Convulsions and severe paralyses are less common. Although the mortality rate has been estimated to be only about 2 to 3 percent, complete recovery from the weakness and myalgia sometimes takes weeks or months.

The symptomatology of gymnothorax poisoning apparently differs from ciguatera in both degree of severity and the type of symptoms present. Gymnothorax poisoning develops more rapidly, is more violent, and convulsions and paralyses are prominent. In a typical case of ciguatera the sensory disturbances, myalgia, and extreme weakness are most pronounced.

4. *Scombroid poisoning.* This type of fish poisoning results from eating scombroid or tuna-like fish (tuna, bonito, skipjack, mackerel) in certain tropical regions. It has recently been reported prevalent during the spring months in the Philippine Sea. The symptoms are histamine-like in nature, consisting of severe headache, flushing of the face, congestion of the soft tissues of the eyes, nausea, vomiting, giant urticaria, and erythema. Patients usually recover within a period of eight to 12 hours. Scombroid poisoning differs from ciguatera in that its clinical manifestations are histamine-like, whereas ciguatera produces neurotoxic symptoms.

CASE REPORTS

The first four cases, reported by one of us (W. M. L.) are representative of ciguatera. This particular outbreak occurred on 9 September 1944 at Tarawa, Gilbert Islands, from ingestion of red snapper (exact species is unknown, but probably *Lutjanus vaigiensis, Lutjanus gibbus,* or *Lutjanus bohar*—all are common red snappers having excellent flavor, but frequently toxic). The snapper was captured by an elderly Australian shipmaster who had traveled in and around the islands since 1914 and had been brought to Tarawa by the armed services because of his intimate knowledge of the Central Pacific Islands. Moreover, for the preceding 10 months he had been assigned the task of supervising a small fisheries operation for the purpose of supplying the military with fresh fish to eat. The fish was caught at 2100, brought to shore, placed in an electric refrigerator and kept there until it was eaten at 2100 the following night. The meal consisted of fish seasoned with salt and pepper, bread, butter, and coffee with sugar and cream. No other foods were eaten. A number of men in the mess hall ate the bread and butter and drank coffee with cream and sugar, but only the four persons (a U. S. Air Force officer, the Australian shipmaster, and two cooks) who ate the fish became sick. All four ate from the same fish, but ingested varying amounts of it. The more fish each person had eaten, the more acute was his illness.

Case 1. A 29-year-old mess sergeant at about 2100 on the night of 9 September ate a 2- by 1- by 1½-inch piece of the forementioned red snapper. About one hour later he developed weakness, profuse sweating, malaise, chilly sensations, and a griping abdominal pain. There was no nausea or vomiting, oral paresthesia, or pruritus. The feeling of weakness and tiredness became progressively worse until he found it very difficult to walk to the latrine. The patient complained of a very pronounced, heavy, tired feeling in his legs. Because of an extreme feeling of exhaustion he was unable to sleep that night. The next day he noticed that whenever he picked up anything cold, he received a

sensation similar to electricity going through his hand, which after a few seconds became very painful. This temperature disturbance lasted for four days. The patient noticed when he got up and walked about the next day that the peculiar, weak, tired feeling came back into his legs and persisted for some time after he ceased motion. He stated that he had never previously felt so weak, tired, and miserable. The patient was acutely ill for about seven days and continued to feel weak for several days thereafter. No laboratory work was performed and no specific treatment was given.

Case 2. A 25-year-old white mess sergeant also ate a 4- by 4- by ½-inch portion of the same red snapper. About one hour later he complained of a peculiar sensation of heaviness in his throat and had difficulty in drinking water. He later felt dizzy, broke out in a cold sweat, and complained of being chilly. Within a short time he developed a severe griping abdominal pain and had to go to the latrine where he remained for the following two hours, having a profuse watery diarrhea. The frequent bowel movements resulted in the patient's rectum becoming raw and painful. There was no nausea or vomiting. During the diarrheal bout the patient began to develop a peculiar dull type of pain in his arms and legs which was aggravated by walking but persisted during rest. The patient stated that he was unable to find comfort no matter what position he took. Extreme exhaustion, weakness, and generalized malaise were the chief complaints at this time. The following morning when he walked he developed the same dull, aching pain in his legs and again it persisted for about 20 minutes after motion had ceased. These leg pains continued for about four days and then gradually subsided. About this time he noticed that whenever he came in contact with a cold object he received a sensation of pins and needles sticking him; a cold shower became a very painful experience. Ice cold objects felt like an electric shock and after a few seconds he was unable to hold the object in his hand. The temperature disturbance continued to be severe for about six days and was present in a mild form for another four days. The patient was acutely ill for seven days and felt very weak for 14 days. Temperature, pulse, and respiration were not affected. Aside from a single injection of morphine to relieve the myalgia on the evening of the first day, no other treatment was administered. No laboratory work was done.

Case 3. A 56-year-old Australian shipmaster ate three small pieces of the forementioned red snapper. About one hour later he noticed a prickly sensation in his mouth when he drank ice water. Ordinary tap water tasted flat and peculiar, but did not elicit the paresthesia. Within a half hour after eating the fish

he developed a diarrhea, having a bowel movement every few minutes for a period of three hours, which left the patient weak and exhausted. There was no nausea or vomiting. The patient developed a generalized malaise and myalgia which made it difficult for him to sit or lie in a comfortable position. Weakness and exhaustion were extreme. About two hours after eating the fish the patient developed the same type of temperature disturbance as in the first two cases. This disturbance lasted for about 14 days. A cool breeze at night would cause a tingling and prickly sensation about his mouth, lips, and body. The patient felt chilly for a period of about two weeks. About four to six hours after eating the fish, the patient developed an intense itching all over his body. When he was awake he was able to refrain from scratching, but when he was asleep he would scratch until he abrased the skin. The pruritus would subside for awhile but anything that would cause him to sweat would start it again. The itching continued to be severe for about 21 days and then gradually disappeared. For about three days the patient had the continual urge to urinate, but whenever he went to the latrine, he was able to void only a few drops. The patient hiccuped almost constantly for four days, a process which greatly exhausted him. He remained on quarters for about 14 days, but it was 21 days before he had sufficient strength to do even light tasks. During this time he lost about 10 pounds of weight. The patient had difficulty in sleeping for a period of about one month. Temperature, pulse, and respiration did not appear to be affected. Laboratory work consisted of a single urinalysis which demonstrated a one plus sugar, but this was not considered to be significant. The patient was given a single parenteral feeding of saline and dextrose on the second day. No other data was available regarding treatment.

Case 4. A 36-year-old Air Force officer ate seven pieces of the forementioned red snapper. About an hour later the patient noticed a prickling sensation in his throat and mouth that tended to increase in intensity. About 30 minutes later, the patient developed a griping pain in his abdomen, went to the latrine several times, and finally remained there for a period of four hours because of a violent diarrhea. During this period he had a "heavy sensation" in his arms and legs, which was described as feeling similar to the type experienced in walking through deep snow for several hours, but many times worse. There was also a feeling of extreme weakness, exhaustion, and myalgia such as was described by the other victims. Resting did not relieve these feelings since there was no position that he could attain which would bring about relief. The chilly sensation and temperature disturbance which has been previously described in the other cases, were also

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present. Nausea and vomiting were absent. An attempt to elicit vomiting was ineffective. About four hours after eating the fish an intense pruritus developed which became progressively worse and prevented any satisfactory rest. The patient was acutely ill and so obviously miserable that the medical officer gave him an injection of morphine which provided some relief and sleep.

The next morning the dull pain that had been present the previous evening returned, affecting the stomach, arms, and legs. The pain was described as a continuous, heavy, dull sensation that became progressively worse. It was observed that with a little movement the pain in his legs increased markedly above the level at which it had previously been when at rest, and that it persisted for about 20 minutes after movement had ceased. Sixty milligrams of codeine and 0.6 gram of aspirin had no effect on the pain. Activity, such as holding a magazine up to read, would so increase the pain in the arms during the first five days that the patient would have to lay the magazine down. The pain was continuously present in the stomach, arms, and legs during the first six days, except when morphine was administered (which was once a day). The pain would then completely disappear for from eight to 10 hours after the injection. On the afternoon of the third day, the patient complained of his teeth aching. On the second and fifth days, the patient tried to eliminate the morphine and took 60 mg. of codeine and 2 grams of aspirin, but with no relief from pain. On the seventh day, the patient took six ounces of whisky in an effort to eliminate the morphine and the pain, but this only aggravated the myalgia. By the fourteenth day, the pain had subsided to the extent that 0.6 gram of aspirin and 0.4 gram of pentobarbital would permit sleep. During this time the patient was steadily losing weight, finally resulting in a loss of 25 pounds. At any time up to the twenty-second day, walking would bring about a recurrence of the pain. The temperature disturbance continued for about 28 days, and the pruritus continued relentlessly until the thirty-fifth day. Then gradually these symptoms subsided. Extreme weakness, myalgia, and joint aches of both shoulders persisted throughout the sixth week. The patient required a barbiturate each night through the eighth week. Temperature, pulse, and respiration did not appear affected. Subsequent contact with the patient revealed that it was necessary for him to keep physical exertion to a minimum for many months.

Because this outbreak took place at Tarawa when field conditions were very primitive and medical facilities were at a premium, the medical work-up was incomplete.

OTHER OUTBREAKS

Report 1. Captain John T. Martin,[42] USAF (MC), formerly Base Surgeon, 1505 Air Base Group, Johnston Island, reported a non-commissioned officer and his family who were poisoned as a result of ingesting a black skipjack, which according to the description given, was probably *Euthynnus yaito* (Kishinouye). The fish was captured in the vicinity of the northern peripheral reef at Johnston Island during the latter part of August 1950.

The fish was taken home, cleaned, and cooked within a short time after capture, so there was no opportunity for spoilage. Neighbors stated that they had captured this same species of black skipjack on previous occasions and had eaten it without ill effect. Members of the family eating the fish consisted of the husband, his wife, and two children. A few hours after the meal, all of the members of the family developed nausea and vomiting, tingling and numbness of the lips, mouth, and extremities, clammy skin, mild diarrhea, intestinal cramps, weakness, myalgia, palpitation, and mild to moderately severe prostration. The acute phase of the episode lasted about 36 hours and then gradually the symptoms subsided. The convalescent period was slow, lasting for several weeks, during which time weakness and myalgia of the legs were the predominant symptoms present. Treatment consisted of bed rest and symptomatic relief during the acute stage. Nicotinic acid was used with the hope of relieving the peripheral neuritis, but it proved to be ineffective. Within a period of two months the family had completely recovered. The family cat also ate a liberal portion of the fish and became very ill, afflicted with vomiting and diarrhea, but appeared to have recovered within a period of 24 hours.

During the period from May 1950 to May 1951 there were said to be about 20 cases of ichthyosarcotoxism at Johnston Air Force Base.

Report 2. Mr. Allen I. Lewis[43] of Contoocook, N. H., reported an outbreak of fish poisoning which occurred at Palmyra, Line Islands, in August 1944, while he was stationed on the island with the U. S. Navy. The causative fish was a red snapper (probably *L. vaigiensis, L. gibbus,* or *L. bohar)* which had been captured off the southwest tip of the island, near Sand Islet, in the vicinity of the boat channel. About 50 fish were served at mess that evening, but only the fish served at one table proved to be poisonous. In this instance all six of the persons became sick.

About four hours after eating the fish, the symptoms, consisting of tautness and tingling of the skin, dryness of the mouth, dizziness and diarrhea, began to develop. There was no nausea or vomiting. The following morning one of the victims drank some ice

water and noticed that it tasted odd, seemed to "stick in his throat," and felt warm instead of cold. One of the group recovered within a period of about 24 hours, but the remainder were acutely ill for several days and then gradually recovered. No information was available regarding treatment.

Report 3. The following data was obtained from the files of Miss Margaret Titcomb, Librarian of the Bernice P. Bishop Museum, regarding three separate outbreaks of fish poisoning which occurred at the U. S. Naval Air Station at Palmyra Island. The original report from which the accounts are quoted was prepared by Lieutenant, junior grade, W. J. McCann, Jr., MC, USNR, on 12 December 1946. The causative fish in each of these cases was red snapper, exact species undetermined.

"On 13 November 1946, five men reported to morning sick call stating that they had been poisoned by eating fish the previous night. Their history is as follows: Fish were caught outside of the reef, killed, cleaned, and eaten promptly. Within a few minutes of eating the fish they noticed a peculiar burning sensation in their throats. This was followed in about three hours by nausea, vomiting, and abdominal cramps. Vomiting gradually diminished and diarrhea began, lasting approximately five hours. About this time, eight hours after ingesting the fish, they noticed a numbness or tingling sensation which some described as burning of hands and feet associated with moderate motor paralysis of these areas. In addition, one man complained of 'stiffness of the face' and 'tight skin over the face.' All complained of vague migratory arthralgia and myalgia along with headache and generalized malaise. One man experienced an attack of syncope related to respiratory embarrassment with evidence of rapid, labored, shallow respiration. All five men stated that cold water, either in the form of showers or drink, caused 'electric shock-like feelings' to go through their bodies. These men were not seen by a medical officer until the morning when the course of the disease was about nine hours old. It was too late for emetics but each man was given a cathartic, put to bed, and given a fluid diet and sedatives. On the second day, two of the men were restored to duty with light assignments and no recurrence of symptoms. On the third day, the remaining men were restored to duty, but of this group, one man, the one who complained of 'facial stiffness,' still complained of peripheral weakness and was given 50 mg. of thiamine hydrochloride orally per day. By the end of the week, all five men were fully recovered."

"On 6 January 1945, a man was evacuated from a merchant ship after having eaten raw red snapper. While the patient was not acutely ill, he had symptoms of gastroenteritis. No evidence of neural involvement was noted."

"On 1 February 1945, 12 members of the crew of a merchant ship were brought ashore suffering from fish poisoning after eating red snapper caught off shore from Palmyra. The men were extremely ill. All patients were given an emetic, sedation, and soda enemas. It was necessary to give five of the men nikethamide (coramine). All survived and were returned to their ship in a few days."

TREATMENT

An attack of fish poisoning does not impart immunity and there is no known specific antidote. The treatment is purely symptomatic. Gastric lavage and catharsis should be instituted at the earliest possible time. In many instances 10 percent calcium gluconate given intravenously has given prompt relief while in others it has been ineffective. Victims suffering from moray eel poisoning appear to be particularly susceptible to violent convulsions and may present difficult nursing problems. Because the convulsions are precipitated by noise, rest, quiet, and sedation are essential. Paraldehyde and ether inhalation have been reported to be effective in controlling the convulsions. Nikethamide or one of the other respiratory stimulants is advisable in cases of respiratory depression. In patients where excessive production of mucus is a factor, aspiration and constant turning are essential. Atropine has been found to make the mucus more viscid and difficult to aspirate, and is not recommended. If laryngeal spasm is present, intubation and tracheotomy may be necessary. Oxygen by inhalation and intravenous administration of fluids supplemented with vitamins, given parenterally are usually beneficial. If the pain is severe, opiates will probably be required. Morphine given in small divided doses has been recommended. Cool showers have been found to be effective in relieving the severe itching. Fluids given to patients suffering from the paradoxical sensory disturbance (temperature upset) should be slightly warm or at room temperature. Vitamin B complex supplements are advisable.

IDENTIFICATION OF POISONOUS FISHES

Native peoples have numerous methods by which they attempt to distinguish a poisonous fish from an edible one. The significance of silver coins, color of the fish, condition of the gills, and position of the scales, *ad infinitum,* is generally based on local superstition rather than on scientific fact. One cannot detect a poisonous fish by its appearance. Moreover, there is no known simple chemical test to determine the edibility of a fish. The most reliable methods involve the preparation of tissue extracts which are injected intraperitoneally into mice, or feeding samples of the viscera and flesh to cats or dogs. Viscera (liver,

intestines, and roe) should never under any circumstances be eaten.

SUMMARY

Poisonous fishes, which are endemic to all warm seas, constitute a serious hazard to military personnel. Numerous outbreaks of intoxication and deaths involving military persons have been reported. Ichthyosarcotoxism is comprised of four clinically distinct types: tetraodon, gymnothorax, scombroid, and ciguatera. They appear to vary in severity, types of symptoms, and species of fish. The disease can be defined as a type of intoxication resulting from the ingestion of a neurotoxin which is present in the bodies of certain fishes, and variously manifested by symptoms of extreme weakness, malaise, pruritus, myalgia, paresthesias of the mouth and extremities, paralyses, and convulsions, generally associated with such gastrointestinal symptoms as nausea, vomiting, diarrhea, and abdominal pain. Death, when it occurs, is from respiratory paralysis. The treatment is symptomatic. A poisonous fish cannot be recognized by its appearance. The public health and military significance of this disease is grossly underestimated and is worthy of much greater attention than it has received.

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